there was really a convergence or whether the beams were parallel, and the convergence an effect of perspective, can only be decided if some approximative measures of the distance of the streamers be ascertained. It appears to have been at a greater distance from the earth than is usually attributed to aurora borealis, having been seen in different parts of Europe and I believe in America. Doubtless the comparison of these observations will give some parallax or approximation to measurement of the distance. I remember about seven or eight years ago seeing an aurora at Chester, where the flashes appeared close to the observer, so that gleams of light continuous with the streamers could be seen between the houses of the town and myself, like the portions of a rainbow intervening between terrestrial objects and the observer. I tried then to ascertain if there was any reflection or other cause of optical illusion, but could not see it as other than a real effect; I seemed, so to speak, to be in the aurora. The effect on the 25th was very different, and gave me the idea of great distance.

The light was sufficient to enable me to tell the time by my watch easily, but not to read newspaper print.

Between half-past six and seven o'clock it faded away, and at from half-past seven to ten had become an ordinary white aurora, confined to the northern portion of the heavens.

115, Harley Street, Nov. 2 W. R. GROVE

ON the evening of the 24th ult. the aurora was most beautifully seen here, and if you have space for it, I will add a further spectroscopic observation to those you have already recorded. I found no continuous spectrum, but two of the lines described by your other correspondent.

1. A line in the light green, much reminding one of the line from the larger nebulæ, but more brilliant and with a peculiar flickering in it. This line was well seen in all parts of the sky, but was specially bright in the auroral patches of silver light.

2. A line in the red, very much like the lithium line, but rather more dusky. This line was only well seen in the rosy patches of the aurora, but could be faintly traced wherever the rose tint at all extended.

When the display of rose-coloured light was at its height, the spectrum from the most vividly coloured portion gave the red line very distinct, while the green line still remained bright by its side. I am quite inclined to agree with your correspondent, T. F., in the conjecture that both these lines are due to hydrogen, though (probably through difference in temperature or pressure) they do not quite agree with the lines of that gas as taken from the discharge in a vacuum tube.

The spectroscope was one of Mr. Browning's small direct-vision 5-prism instruments adapted for star purposes.

It may be worthy of note that the belts of Jupiter are highly coloured at the present time. The equatorial zone is of a distinct dark ochre colour, deepening to red brown as it approaches the lower edge (in an inverting telescope); two thin belts above are slate purple, and a darker belt below is of a deep purple, with a faint trace of rose colour.

The planet was thus seen on Nov. 2, at 9 p.m., not far above the horizon, and in bright moonlight, in a 8½ Browning's silvered spectrum with achromatic eye-pieces—144, 305, and 450; best I think with 144.

Guildford, Nov. 5 J. R. CAPRON

Clouds

I DO not think Prof. Poey's "New Classification of Clouds," published in NATURE of Sept. 8th, does much to advance science. I see no use in any classification of clouds, unless it is based on their mode of formation, and, so far as I see, there are but three ways in which it is possible for clouds to be formed. These are:—

1. The cooling of a mass of air *in situ* by radiation. This forms stratus.

2. The cooling of a mass of air by diminished pressure when it flows in an ascending column. This forms cumulus. A modification of this process is when (according to Espy) sudden expansion takes place above, so as to diminish the pressure through the entire height of a column of air, and, in consequence of the cold due to the diminution of pressure, to produce condensation of vapour throughout the column. This is Espy's explanation of waterspouts.

3. The cooling of a mass of air by coming into contact with a cooler mass of air than itself. This forms cirrus.

Of course these three modes of formation may be modified and combined in endless ways. To mention one of the simplest: A cloud which has begun to form as a cirrus or cumulus, may become a centre from which heat is radiated, and thus go on forming as a stratus.

It is in the highest degree unphilosophical to reject stratus as a species of cloud on the ground that it is "not a cloud properly so called, but a mist or hoar frost." A cloud and a mist do not differ fundamentally.

Prof. Poey is, however, right in saying that cumulus is not a distinct species of cloud. It is only a cloud which (in consequence, I believe, of the loss of electrical tension) has begun to run together into raindrops. JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim

Extreme Seasons

A GREAT deal of speculation has been indulged in to account for the extreme seasons that have prevailed over so large a part of the northern hemisphere during the last few months. In this country, as we are subject to extreme seasons, more particularly as regards the rainfall, the subject is one of peculiar interest. In a paper read before the California Academy of Sciences in February on the subject of our extreme seasons, I brought forward a number of observations to show that these were due to broad polar and equatorial currents occupying large portions of the earth's surface continuously, and without much perpendicular or horizontal disturbance, except at the borders where the currents meet. The facts I then brought forward showed that from October to the middle of February a northerly current prevails over this portion of the American continent, extending from one to two hundred miles to the westward of San Francisco to the eastern edge of the Mississippi valley, whilst a southerly current prevails over the eastern side of the continent as far as the Atlantic. The southerly current to the westward extends uninterruptedly across the whole breadth of the Pacific to the coast of Japan. This same distribution of air currents without much perpendicular or horizontal mixing has apparently continued during the summer, and acounts, I think, satisfactorily for the extreme heat that has marked the continental climates over so large a part of the northern hemisphere. Nor is it surprising that the summer temperature on the continents should be so universally hot, as a horizontal wind, either from the north or from the south, blowing over the land in summer must necessarily be a hot wind. That there is no cosmical cause for this elevated temperature is proved by the extremely low summer temperature prevailing over the Pacific between this place and Japan. The mean temperature, as ascertained by observations made on board the mail steamships between here and Japan was, for Nov. 1869, 70°·2, for January, 62°·9, for May, 1870, 61·9, for July, 65·7, giving a mean of 2°·7 less for May and July than for January and February. The difference in favour of the winter temperature would be still more marked were the coast temperatures eliminated, as they perhaps should be; as these were much above the mean in summer and below the mean in winter. As to the causes that lead to the peculiar distribution of the air currents in certain seasons, I have not the slightest idea, but I think that, admitting the fact, it affords a satisfactory explanation of anomalous temperatures both in winter and summer.

San Francisco, California, Sept. 4 JAMES BLAKE

Cyclones

CYCLONES are commonly regarded as exceptional phenomena of the atmospheric circulation; and we see in text-books statements as to the seasons of the year at which they are most apt to occur, descriptions of the premonitory signs which herald their approach, and directions to aid ships in avoiding the most dangerous portions of the storm-field. In short, each cyclone is regarded as an exceptional fact, an isolated burst of fury from the old storm-god Hurakan.

The writer has lived all his life on the great highway of cyclones, at Charleston, South Carolina; and from the observations of many years, has been led to conclude that this commonly received view embraces only those cyclones which, on account of their rotatory violence, really do threaten destruction on land and sea; and that consequently it overlooks a most important series of phenomena, which, though they do not so forcibly arrest attention, are even perhaps more significant in a scientific point of view. Though *destructive cyclones* or hurricanes are

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ortunately rare, cyclones or grand rotatory movements of the atmosphere are, at least on certain portions of the earth's surface, of *every-day occurrence*. In Charleston, Savannah, and along the coast of South Carolina generally, the writer knows from experience that very few, if any, changes of wind are to be observed, but such as are due to the cyclone which happens just then to be passing on its northward journey; and even the apparent exceptions are probably not difficult of explanation.

There is in short an atmospheric "Gulf Stream," whose course, beginning somewhere eastward of the Caribbean Sea, is nearly the same as that of the oceanic "Gulf Stream," and this atmospheric stream is composed of an endless succession of cyclones chasing each other ceaselessly up towards the polar regions, along the track recognised as that of great hurricanes. These cyclones vary within very wide limits both as to velocity of rotation and velocity of translation, as well as in diameter, and all the characters usually ascribed to such atmospheric movements. Many of them exhibit no wind stronger than a pleasant breeze in any part of their field; and a few have so gentle a motion, at least in some parts of their circuit, as will not agitate an ordinary vane; a few are almost wholly without clouds, and very many wholly without rain or lightning. Their effect upon the barometer, when appreciable, must generally be very slight; but in temperature they are usually divided into a warm and a cool semicircle by a line which, in Charleston, lies about S. W. and N. E.

Observation of the winds, during a voyage in a sailing vessel from Charleston to Liverpool, along the course of the Gulf Stream, has satisfied the writer that this *stream* continues unbroken between these two points, and this conclusion was strengthened by repeating these observations between Liverpool and New York. In the former voyage, hardly one of the cyclones which passed over gave more than a stiff breeze, while in the latter, from Cape Clear to Sandy Hook, every cyclone was a storm, and one of them was reported by the captain, on his arrival, as a "hurricane."

The causes of this aërial current, and its connection with the circulation of the whole terrestrial atmosphere, it is not the writer's purpose at present to discuss, though he considers the discussion one of almost *cosmical* importance. But the existence of such a stream is a fact of practical commercial value, in fixing the natural highways for sailing vessels between Liverpool and the Atlantic and Gulf ports of the Southern States. Obviously the short route from Northern Europe to those ports will be that southward along the coast of Europe until reaching the trade winds, then westward to strike the cyclonic current in the neighbourhood of the West Indies, and then, if bound to Atlantic ports, northwestward with that current. When bound, on the contrary, from the Southern ports to Northern Europe, the short route is obviously that along the Gulf Stream, which is also that with the current of the atmospheric stream. To reverse this practice, either way, is deliberately to sail "against wind and tide," if such a stream exist.

The flow of atmospheric *waves* which, in a recent work, has been described as setting from the coast of America towards Europe, though the writer has not seen that work, he believes cannot be other than the flow of cyclones in that portion of the atmospheric stream lying between the vicinity of New York and the English Channel. The cyclonic character is not always distinct, and sometimes is completely masked by the great distance of the observer from the centre, and the consequent apparently rectilinear course of the wind; and the chances of mistake are still further increased when the observer is moving in a course parallel to the path of the centre of the cyclone.

These observations have already been brought to the notice of the Smithsonian Institution, and the writer hopes that something will be done in America towards the comprehensive, precise, and detailed inquiry which the subject demands. But unless attention of the same kind be given in Great Britain, and in the voyages of the Atlantic steamships, the resulting information will remain incomplete. JOHN M. CRADY

Curator of the Museum of the College of Charleston

Charleston, U.S., Sept. 13

Singing of Swans

IN times ancient and modern "singing of swans" has been reckoned by naturalists among "vulgar errors" and groundless superstitions. It may therefore be interesting to your readers to hear that swans actually do sing, which I can testify by my own personal experience.

From my ninth to my eighteenth year I lived at a place in the west of Iceland, called Gufudalur. It is situated at the end of a small firth, called Gufufjördur, which is so shallow that by low water it is almost dry: the bottom of the firth is covered with sea-grass (marhálmur). In this firth hundreds of swans gather together all the year round, except during the winter months, when the firth is covered with ice; and in the month of August, which is their moulting season, when all of them leave this firth and go to another not far off, called Gilsfjördur. There is no apparent reason for this migration, as Gufufjördur seems in every way as safe and convenient for them during this season as Gilsfjördur. Tradition therefore accounts for this migration in the following manner:—Once upon a time two widows lived one on each side of Gufufjördur. At that time the swans did not go away during the moulting season, and the widows used to gather great quantities of swans' feathers, which are sold in Iceland at the present day at a halfpenny a piece. Thus the swans' feathers formed a considerable item in the income of the two widows. Once, however, one of the widows gathered feathers on a piece of land belonging to the other. A quarrel arose, and one of the widows uttered a spell to the effect that henceforth all the swans should leave Gufufjördur during the moulting season. I will not vouch for the correctness of this tradition, but the fact remains that this migration takes place annually during the above-mentioned season.

During nine years I have heard the singing of the hundreds of swans which gather together in Gufufjördur. In the morning and evening their singing is so loud that it can be heard miles away, and the mountains on both sides ring with the echo of it, for at that time every individual swan seems to join in the chorus. This is, indeed, a wonderful concert. The singing of the swan has not the least resemblance to the cackling of geese or the quacking of ducks. In fact, its voice is unlike the voice of any other bird that I have heard; it seems so clear and full, and has, as it were, a metallic ring in it. When it is calm and clear in the morning or the evening, the swans fly along the valley towards the mountains in parties of seven or nine, sometimes only three; as far as I can remember they are always in odd numbers. During their flight, they either keep in a straight line, one after another, or they form a triangle, leaving an open space in the middle: the foremost swan sometimes emitting single sounds at short intervals. The tradition of the singing of the swan being sweetest just before its death is well known in Iceland; but I am unable either to deny or to confirm this tradition, because I have never been present at the death of a swan.

The swans of Gufufjördur do not lay eggs there, and I am inclined to think that the most of them do not lay eggs at all, for their number in this firth does not seem to be less from the middle of May to the end of July, which is the season during which swans in Iceland lay eggs and bring up their young ones. On the mountains round Gufufjördur there are many small lakes or tarns, and on the banks of those lakes I have seen swans build nests and lay eggs; as a rule there is only one pair on each lake, and, strange to say, these swans sing but very seldom.

JÓN A. HJALTALIN (Icelander).

152, St. Paul's Road, Camden Square, N.W.

State Aid to Science

I REGRET that I should have worded my lecture on Cosmical Physics in such a way as to leave it doubtful how the central establishment I spoke of was to be supported.

Unable myself to conceive the possibility of such an institution being properly supported otherwise than by State aid, I fear I did not sufficiently realise that others might not be of the same opinion. At the time of the establishment of the present Meteorological Office, it was acknowledged that private scientific enterprise cannot be expected to furnish the money requisite to carry on an extensive system of meteorological observations, and the same conclusion equally applies to the other branches of cosmical inquiry.

The most convincing proof of the justice of this conclusion lies in the fact that the British Association, who have hitherto contributed a large portion of their income to advance terrestrial magnetism, find that they cannot do so much longer without detriment to other subjects which have an equal claim upon their liberality. They have therefore resolved to give up their connection with the Kew Observatory after the autumn of 1872. Further proof is surely needless. B. STEWART

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